improvement of certain economic characters in corn by continuous selection, are given careful consideration, as also the theoretically more important work of SHULL and EAST. Full accounts of the experiments in breeding other cereals and various fodder plants under way at several experiment stations follow. The writers furnish what is perhaps the best brief general critique of LUTHER BURBANK and his much be-written work that has yet appeared, and which affords a refreshing change from the usual reiterated adoration of the stoneless prune, the plumcot, and the spineless cactus, to which our ears have so long been accustomed. What is still more interesting is the very appreciative and much deserved commentary on the valuable work of HANSEN in the amelioration of the wild fruits of the northwest plains region. The authors have been at pains to grasp thoroughly and put down minutely the rather complex morphology of our national Department of Agriculture and its protean subdivisions, accompanied by an astonishing genealogical tree of its ramifying functions and personnel that is worth that department's while to reproduce in English. The independent agricultural colleges visited were those of Kansas, South Dakota, and New Jersey, and those with university affiliations were Cornell, Wisconsin, Illinois, Minnesota, Nebraska, California, and Arizona, the organization and equipment being noted in each case. Agronomic methods, soil culture, and agricultural ecomomics in general are reviewed so far as the writers had time and opportunity to observe. Full and detailed accounts occur of the apparatus in use at the various experiment stations and botanical institutes visited. The authors display throughout a well balanced judicial temper in comparing American and European conditions as regards agricultural education and experimental work. The *Pracht* and *Glanz* of some of our munificently endowed American scientific and educational institutions do not conceal from the acute vision of the authors of this *Bericht* the humiliating circumstances that too often afflict the occupants of their chairs. Meager salaries, incessant teaching, papers and publications issued under forced draft, and the precious requirements of our American red-tape technique, which call for the perpetual pumping out of reports of scientific progress up to Saturday night, all of this has not escaped the European commentators' attention. "Dabei ist es jedoch noch immer als ein schwerer Fehler zu bezeichnen, dass die amerikanischen Mäzene zwar der Wissenschaft mit Recht herrliche Paläste bauen, die Diener der Wissenschaft jedoch—die Professoren und Dozenten—regelmässig vergessen" (p. 150).—H. F. ROBERTS.

Experiments in plant physiology.—HEALD and LEWIS have published[4] a set of experiments in plant physiology, designed to form the basis for a year of university work. The experiments are grouped under four heads arranged in the following order: growth (exps. 1–15), movement of water and gases (exps. 16–61), nutrition (exps. 62–115), and irritability (exps. 116–150). The

[4] HEALD, F. DEF., and LEWIS, I. M., Experiments in plant physiology. pp. 70. *figs. 24*. Austin, Texas: the authors. 1910.

authors apparently feel it desirable to teach as many facts as possible through demonstration or experiment. This probably accounts for the large number of experiments used for the year's course, and for their qualitative and in many cases extremely elementary character. The experiments stand quite in contrast with the aims set forth by GANONG in his manual for a college course in this subject. "The emphasis is thrown, for advanced or college work, not upon qualitative results obtained by students from apparatus of their own making, but upon quantitative results obtained from practically accurate or normal apparatus manufactured expressly for its particular use." The lack of reliability in much of the data of plant physiology is due to the loose qualitative methods used in the subject. I know no better place to begin the development of reliable quantitative technique than in college and university courses. GANONG has repeatedly urged this necessity. Time-honored experiments that have taught misconceptions ought to be dropped from manuals or modified so as to teach the truth. As an illustration, we may mention the use of the potassium bichromate and ammoniacal copper sulphate screens for the purpose of determining the relative photosynthetic value of red and blue light. KNIEP and MINDER[5] have shown that the results obtained in this case are due to different intensities and not to different qualities of the light. This experiment is of significance only when the screens are so arranged as to give equal energy values. Under this condition KNIEP and MINDER found equal photosynthetic activity for the two ends. When exact chemical methods give more trustworthy results (as is the case in experiment 35 on the retention of salts by soil), one can hardly see why they should be avoided in a university course.—WILLIAM CROCKER.

Outlines of geologic history.—Under this title a series of essays involving a discussion of geologic correlation is published.[6] The essays were presented before Section E at the Baltimore meeting (1908) of the American Association, and include three of interest to botanists: "The upper paleozoic floras, their succession and range," by DAVID WHITE; "Succession and range of mesozoic and tertiary floras," by F. H. KNOWLTON; "Origination of self-generating matter and the influence of aridity upon its evolutionary development," by D. T. MACDOUGAL. The first two papers cited present in convenient outline form the succession of floras from the middle Devonian to the end of the Tertiary. Naturally the presentation is chiefly stratigraphic, with suggestions as to climatic changes; but the material for a consideration of the historical basis for phylogenetic conclusions is thus made more available. MACDOUGAL'S essay, as the title suggests, is highly speculative, but the basis of facts which

[5] BOT. GAZETTE **49**:390. 1910.

[6] Outlines of geologic history with especial reference to North America. Symposium organized by BAILEY WILLIS. Compilation edited by ROLLIN D. SALISBURY. Chicago: The University of Chicago Press. 1910. $1.50.